Application Data

Fan Motors and Drives for Central Station Air-Handling Units

60 Hertz

INTRODUCTION

The same careful attention given to the selection of the fan should be afforded to the selection of the fan motor and drive. It is the purpose of this publication to define the major factors involved in the selection procedures for these most important components

Factory Installed or Field Supplied? — This decision is a very basic and important one. Basic, in that it needs to be made early, in the ordering phase of the job. Important, in that the results of the motor and drive selection directly affect the satisfactory performance and economical operation of the equipment selected.

Limitations — Every fan has limitations relating to maximum speed and shaft horsepower. Refer to Table 1 for maximum fan horsepower and fan speed limits on standard 39E/ER air handlers.

Fixed or Variable? — Fixed drives are recommended for all applications. However, variable pitch drives are often specified because they permit fan speed (thus, system air volume) to be easily field adjusted. Unfortunately, this advantage is usually offset by balancing problems inherent in their design that cause vibration and premature belt wear, especially in the higher horsepower drives. For this reason, *variable pitch drives with motors larger than 25 hp are not recommended and are not available from the factory.*

NOTE: In the event that such a field-supplied drive proves unsatisfactory, contact the drive supplier for any additional technical assistance required

Service Factor — Almost all drives are subject to occasional overload, consequently it is good engineering practice to have ample capacity designed into the drive to take care of these overloads. Although higher service factors will extend the belt life, they will also increase the drive loss, resulting in reduced energy efficiency. A reasonable service factor for fans is considered to be 1.2 to 1.5.

Drive Loss — Proper allowance should be made so the motor selected does not run overloaded. The major factors in drive efficiency are the load on the belt and the bending radius of the belt around the pulley. Belt tension, operating temperature and drive alignment also contribute to drive losses. Considering these factors, the drive loss is generally between 2 to 6% of the maximum fan brake horsepower. Using a 3% selection allowance is reasonable.

Motor Speed — Generally, 1800-rpm motors are used on 39E Series air handlers, All factory-supplied standard drives are designed for 1800 rpm, except for some smaller airfoil units that require 3600-rpm motors due to space limitations. Larger motors in certain size units may require an optional (L5) cabinet extension.

Table 2 gives a complete summary of standard motor sizes, limitations, and speeds. Tables 3 and 4 give a complete summary of space and sheave limitations of all fan unit sizes with all NEMA standard motors.

Open Drip Proof (ODP) or Totally Enclosed Fan-Cooled (TEFC) Motors (Fig. 1) — ODP motors are recommended. Compared to TEFC motors, ODP motors are less expensive, have a higher service factor and are normally more readily available from vendor stock.

The 39E/ER motors are mounted in the unit airstream and operate with cool air passing over the motor. This provides additional cooling to windings and motor bearings and increases the life of the motor, thereby reducing the need for a TEFC motor.

The ODP motors have ventilation openings that allow air over and around the motor windings to keep the temperature as low as possible.

The TEFC motors utilize an internal fan to cool the motor windings. They do not have any openings for ventilation air.

Totally enclosed air over (TEAO) motors rely on strictly unit airflow to cool the motor windings. They do not have an internal fan or openings for ventilation air.

Voltage — The nominal power system voltage will normally be more than the motor nameplate voltage. NEMA standards are as follows:

Nominal Power System Voltage	Motor Nameplate Voltage
208	200
240	230
480	460
600	575

Field-Installed Inverters — High-efficiency motors are recommended whenever an inverter is field installed to control fan speed. High-efficiency motors can handle the extra heat generated much better than standard motors. The projected life of the motor when controlled by an inverter will be improved if a high-efficiency motor is used.

FACTORY-SUPPLIED DRIVES

Factory-Supplied Standard Drives are available for the motors shown in Table 2, in the rpm range defined by the minimum-maximum values given, subject only to the following qualifications:

1. Variable speed drives are available with a minimum adjustment of ±7% (i.e., from .93 to 1.07) of any rpm that falls within the range.
2. Fixed speed drives are available within ± 2% (i.e., .98 to 1.02) of any specified rpm within the range.
3. The minimum service factor will be 1.4 on all factory-supplied standard drives. (Based on motor hosepower, not brake horsepower. Actual service factor is normally much higher.)

The factory-supplied standard 39E/ER drives have been selected on the basis of performance, availability and cost. They cover all normal requirements, but may not meet every conceivable application. Non-standard applications should be reexamined closely for possible correction to a standard application.

Standard factory drives are most desirable because of cost effectiveness, optimized performance and timely shipment.

Follow the 5-step factory-supplied drive selection procedure on page 3 and order by 39E/ ER unit size, fan rpm and type, fixed or variable. *Do not use drive package numbers from previous literature.* Do included all relevant motor information — hp, voltage, motor rpm, type and frame size.

Factory-Supplied Special Drives are available on special order (quote control) and normally will require extended lead time and additional cost. Consult your Carrier representative for additional information.

Table 1 — Motor Hp/Fan Speed Limitations for Minimum Bearing Life

UNIT SIZE	MAXIMUM MOTOR HP*		MAXIMUM FAN SPEED*		
	FC	AF	FC	AF	AF Optional High-Speed Wheel
08	7½	10	2000	4335	4983
11	15	15	1600	4067	NA
13	15	15	1300	3161	3633
17	20	20	1100	2858	3285
19	20	25	1100	2547	2997
23	25	25	1200	2255	2653
29	25	30	1000	2079	2446
36	30	40	900	1886	2219
39	30	40	900	1886	2219
48	40	50	770	1611	1928
57	50	75	650	1397	1643
75	—	100	—	1412	1497
90	—	100	—	1334	NA

AF — Airfoil
FC — Forward Curved
NA — Not Available

*Indicates maximum hp and speed that can be used to obtain 200,000 hour average minimum bearing life (B10 life of 40,000 hours)

FIELD-SUPPLIED DRIVES

Field-Supplied Drives are subject to the physical limitations and functional constraints of the motor and air handler. See Fig. 1 and Tables 3 - 5. Since technical assistance and support after the sale will be required, choose the supplier with care. Deal with an established supplier of known reputation, and share this booklet with him.

Field Selection Guide

STEP	ACTION	INFORMATION	REFERENCE
1.	**Determine fan performance**	Unit size Wheel type (FC/AF) Fan speed (rpm) Fan hp	Fan Performance Catalog, 39E-10P, or the Carrier Electronic Catalog.
2.	**Check performance limitations**	Maximum rpm Maximum hp	Table 1
3.	**Check mounting space limitations**	Motor type, hp, rpm and frame size	Tables 3 and 4
4.	**Determine motor mounting designation**	F1 or F2	Table 6
5.	**Determine drive type**	Variable or fixed	Page 1
6.	**Belt center distance**	Maximum Minimum	Table 5
7.	**Determine maximum sheave dimensions**	Width Radius	Tables 3 and 4 Fig 1
8.	**Determine shaft diameters**	Fan Motor	Table 5 Fig 1

FACTORY-SUPPLIED DRIVE SELECTION PROCEDURE

1. Obtain your fan speed and brake horsepower requirements from the fan data in Catalog 39E-10P or from the Carrier Electronic Catalog.
2. Add 3% to the fan brake horsepower to compensate for drive loss.
3. Select motor by horsepower, type, frame size, voltage and motor rpm.
4. Select either fixed or variable pitch drive.
5. Examine the factory available drive speed range on Table 2. If not listed, re-evaluate your selection for possible correction or request a quote control.

   All standard applications should be covered in the Table.

Example: Having determined the fan requirements from the 39E-1PD Catalog Selection Procedure, select a motor and drive.

Given: 39ED23 with FC fan
12,500 cfm
3.67 in. total pressure

1. From the 39E-10P Fan Catalog: 920 rpm
   12 bhp
2. Allow for drive loss: 12 bhp x 1.03 = 12.36 bhp
3. Select motor per job specifications: 15 hp, ODP, 254T frame, 460/3/60, 1800 rpm
4. Select a variable drive per job specifications.
5. From Table 2, determine the available speed range for factory-supplied standard drive is 671 - 1184 rpm. 920 rpm is a valid selection.

Table 2 — Motor Hp Limitations and Fan Speed Ranges for Factory Supplied Standard Drives

39E/ER SIZE	SEE LEGEND	MOTOR HP	FRAME SIZE	VARIABLE				FIXED			
				FC		AF		FC		AF	
				Min	Max	Min	Max	Min	Max	Min	Max
08		2	145T	935	1217	2135	2457	794	1257	2349	2535
	C	3	145T	—	—	2407	2769	—	—	2486	2933
		3	182T	1004	1456	—	—	893	1539	—	—
	C	5	182T	—	—	2914	3352	—	—	2771	3170
		5	184T	1135	1825	—	—	912	1785	—	—
	A	5	184T	—	—	2914	3352	—	—	2771	3519
	C	7 5	184T	—	—	3287	3781	—	—	3752	3984
		7.5	213T	1187	1944	—	—	1113	1785	—	—
	C	10	213T	—	—	—	—	—	—	3752	4310
11		2	145T	547	901	1305	1725	543	934	1282	1826
		3	182T	596	1086	1637	2072	592	1162	1640	2158
		5	184T	684	1343	1905	2513	623	1377	1875	2671
		7 5	213T	763	1390	2228	2876	756	1484	2211	3028
	C	10	213T	—	—	2558	2943	—	—	2542	3095
		10	215T	1006	1390	—	—	957	1523	—	—
	A	10	215T	—	—	—	—	—	—	2542	3095
	C	15	215T	—	—	—	—	—	—	2798	3543
	C	15	254T	—	—	—	—	1213	1420	—	—
	B	15	254T	—	—	—	—	—	—	2800	3546
13		2	145T	571	760	1144	1486	578	784	1128	1607
		3	182T	605	902	1381	1769	611	945	1339	1871
		5	184T	627	1280	1572	2157	626	1297	1576	2245
		7 5	213T	812	1287	1940	2501	703	1275	1924	2635
		10	215T	949	1265	—	—	958	1313	2192	2776
	C	10	215T	—	—	2155	2522	—	—	—	—
	C	15	215T	—	—	2461	2831	—	—	2376	3008
	C	15	254T	—	—	—	—	1137	1313	—	—
	B	15	254T	—	—	—	—	—	—	2377	3010
17		3	182T	493	778	1025	1458	480	826	1017	1568
		5	184T	499	1007	1355	1745	497	1070	1344	1840
		7 5	213T	551	1070	1588	2032	542	1107	1570	2150
		10	215T	637	1074	1831	2337	641	1088	1809	2478
		15	254T	782	1077	1989	2452	785	1106	2011	2547
		20	256T	963	1109	—	—	996	1122	—	—
	B	20	256T	—	—	2297	2643	—	—	2256	2747
	C	20	256T	—	—	2297	2643	—	—	2256	2747
19		3	182T	497	736	917	1195	501	774	899	1281
		5	184T	523	1027	1136	1456	511	1004	1124	1539
		7 5	213T	561	1079	1349	1723	545	1071	1333	1826
		10	215T	612	1082	1544	1968	589	1071	1525	2088
		15	254T	697	1083	—	—	702	1080	1668	2284
	B	15	254T	—	—	1686	2158	—	—	—	—
	C	15	254T	—	—	1686	2158	—	—	—	—
		20	256T	873	1080	—	—	913	1101	1921	2339
	B,D	20	256T	—	—	1880	2288	—	—	—	—
	C	25	256T	—	—	2097	2413	—	—	2126	2489
23		3	182T	477	618	835	1063	474	677	824	1129
		5	184T	493	778	972	1257	480	826	965	1375
		7 5	213T	531	924	1161	1480	516	976	1147	1571
		10	215T	575	1046	1352	1710	568	1116	1353	1783
		15	254T	658	1140	1457	1968	671	1184	1481	2029
	C	20	256T	831	1146	1641	2019	834	1175	1663	2106
	B	20	256T	831	1146	1641	2019	834	1175	1663	2106
	C	25	284T	992	1142	1842	2120	980	1193	1885	2206
	B	25	284T	992	1142	1842	2120	980	1193	1885	2206
29		5	184T	393	614	752	1038	390	657	757	1078
		7 5	213T	414	729	960	1212	410	762	960	1265
		10	215T	456	832	1109	1406	451	885	1111	1464
		15	254T	474	951	—	—	474	1020	—	—
	C	15	254T	—	—	1244	1621	—	—	1224	1743
	B	15	254T	—	—	1244	1621	—	—	1224	1743
		20	256T	602	952	—	—	599	1015	—	—
	B,D	20	256T	—	—	1393	1767	—	—	1373	1881
		25	284T	726	946	—	—	722	989	—	—
	B,D	25	284T	—	—	1547	1779	—	—	1525	1856
	D	30	286T	—	—	—	—	—	—	1655	1938
36		5	184T	356	514	681	874	354	547	674	923
		7 5	213T	377	610	819	1029	369	636	818	1077
		10	215T	404	701	946	1187	392	741	944	1242
		15	254T	415	835	1057	1359	416	896	1048	1434
		20	256T	502	876	1196	1519	514	906	1197	1576
		25	284T	604	872	1309	1626	591	914	1332	1687
		30	286T	—	—	—	—	697	918	1438	1683
	B	40	324T	—	—	—	—	—	—	1497	1824
	C	40	324T	—	—	—	—	—	—	1497	1824

Table 2 — Motor Hp Limitations and Fan Speed Ranges for Factory Supplied Standard Drives (cont)

39E/ER SIZE	SEE MOTOR LEGEND	FRAME HP	SIZE	VARIABLE				FIXED			
				FC		AF		FC		AF	
				Min	Max	Min	Max	Min	Max	Min	Max
39		7 5	213T	406	561	874	1006	425	520	916	1067
		10	215T	464	693	1078	1240	448	633	1053	1130
		15	254T	504	725	1078	1240	475	763	1053	1293
		20	256T	549	854	1269	1459	539	826	1245	1443
		25	284T	584	805	1334	1534	583	862	1402	1582
		30	286T	—	—	—	—	583	862	1492	1685
		40	324T	—	—	—	—	—	—	1574	1785
48		10	215T	416	478	—	—	381	495	—	—
		15	254T	404	631	987	1135	410	633	958	1109
		20	256T	436	691	1073	1235	448	711	1065	1248
		25	284T	501	753	1233	1419	475	763	1175	1406
		30	286T	—	—	—	—	503	750	1251	1475
		40	324T	—	—	—	—	516	750	1340	1609
		50	326T	—	—	—	—	—	—	1492	1733
57		15	254T	339	488	880	1012	323	397	841	939
		20	256T	371	534	880	1012	361	523	903	1020
		25	284T	389	597	919	1198	381	593	903	1137
		30	286T	—	—	—	—	408	645	1046	1206
		40	324T	—	—	—	—	408	645	1100	1353
		50	326T	—	—	—	—	486	645	1234	1406
		60	364T	—	—	—	—	—	—	1309	1406
		75	365T	—	—	—	—	—	—	1405	1566
75		15	254T	—	—	699	805	—	—	642	753
		20	256T	—	—	777	895	—	—	765	838
		25	284T	—	—	777	895	—	—	806	888
		30	286T	—	—	—	—	—	—	861	955
		40	324T	—	—	—	—	—	—	953	1082
		50	326T	—	—	—	—	—	—	1008	1174
		60	364T	—	—	—	—	—	—	1086	1248
		75	365T	—	—	—	—	—	—	1166	1313
	C	100	404T	—	—	—	—	—	—	1243	1313
	B	100	405T	—	—	—	—	—	—	1231	1313
90		15	254T	—	—	584	672	—	—	547	678
		20	256T	—	—	584	672	—	—	664	774
		25	284T	—	—	699	805	—	—	683	840
		30	286T	—	—	—	—	—	—	723	830
		40	324T	—	—	—	—	—	—	763	915
		50	326T	—	—	—	—	—	—	854	991
		60	364T	—	—	—	—	—		907	1069
		75	365T	—	—	—	—	—	—	967	1082
	C	100	404T	—	—	—	—	—	—	1042	1281
	B	100	405T	—	—	—	—	—	—	1042	1281

Motors are 3600 rpm, all others are 1800 rpm

LEGEND

A = TEFC only
B = TEFC only with cabinet extension option L5 (Requires Quote Control on sizes 75/90)
C = ODP only
D = ODP only with cabinet extension option L5

NOTES
1 All motors are 60 Hz
2 See Table 1 for limitations based on bearing life
3. Standard drives do not fit 2-speed motors A Quote Control is required for a special drive when used with 2-speed motors

Table 3 — Maximum Physical Motor Frame Size and Maximum Allowable Sheave Width (in.) — Forward-Curved Fan

UNIT SIZE	IGV OPTION	MOTOR FRAME															
		145T		182T		184T		213T		215T		254T		256T		284T	
		Motor Type															
		ODP	TEFC	ODP	TEFC	ODP	TEFC	ODP	TEFC	ODP	TEFC	ODP	TEFC	ODP	TEFC	ODP	TEFC
08	W/O IGV's	3 6	3 6	5 7	5.7	5.7	5.7	5.0	5.0	3.3*	3.3*						
	With IGV's	4.7	4.7	7.4	5.8	7.4	4.8	6.8	4.4	4.0*							
11	W/O IGV's	7 3	7 3	6 7	6 7	6 7	6 7	6 0	6 0	6 0	6 0	4 7					
	With IGV's	7 8	7 8	7 3	7 3	8 9	6 3	7 9	5 5	5.9	5 9†	5 3†					
13	W/O IGV's	7.2	7.2	6.7	6.7	6.7	6.7	6.0	5.6	6.0	4.4	4.2					
	With IGV's	6.5	6.5	6.0	5.1	6.0	4.1	5.2	5.2†	5.1†	5.1†						
17	W/O IGV's			8 1	8 1	8.1	8 1	7 2	7 2	7 2	7 2	6 4	6 4	5 0	5 0		
	With IGV's			8.6	8.6	8.6	8.6	7.8	7.8	7.8	7.8	7.1	5.1	5.7	5 7†		
19	W/O IGV's			8.0	8.0	8.2	8.2	7.4	7.4	7.4	7.4	6.5	6.5	5 1	5 1		
	With IGV's			8 5	8.5	8.5	8.5	7.8	7 8	7 8	6.4	7.0	7.0†	5 6†	5 6†		
23	W/O IGV's			8.4	8.4	8.4	8.4	7.7	7.7	7.7	7.7	6.8	6.8	5 5	5.5	5 5	4 8
	With IGV's			8 3	8 3	8 3	8 3	7 5	7 5	7 5	6 3	6 8	6 8†	5 3†	5 3†	5 3†	5 3†

UNIT SIZE	IGV OPTION	MOTOR FRAME															
		182T		184T		213T		215T		254T		256T		284T		286T	
		Motor Type															
		ODP	TEFC	ODP	TEFC	ODP	TEFC	ODP	TEFC	ODP	TEFC	ODP	TEFC	ODP	TEFC	ODP	TEFC
29	W/O IGV's	4.3*	4.3*	4 3	4 3	3 6	3 6	3.6	3 6	5 3	5 3	5 3	5 3	4 8	4 8		
	With IGV's	5 3*	5 3*	5 3	5.3	4 5	4 5	4 5	4 5	6 3	6.3†	6 3†	6 3†	5 8†	5 8†		
36	W/O IGV's	5 5*	5 5*	5 5	5 5	4 7	4 7	4.7	4 7	6 5	6 5	6 5	6 5	5 7	5 7	5 6	5 6
	With IGV's	6.5*	6.5*	6 5	6 5	5 8	5 8	5.8	5 8	6 3	6 3	6 3	6 3	5 8	5 8	5 8	5 6
39	W/O IGV's			5 5*	5 5*	4 7	4 7	4.7	4.7	8 7	8 7	7 5	7 5	7 5	7 5	6 0	6 0
	With IGV's			5.4*	5.4*	5.4	5.4	5.4	5.4	10.0	9.0	8.2	7.2	8.2	6 5	7 8	5 0
48	W/O IGV's					8.0*	8 0*	8 0	8.0	8.0	8.0	7 5	7 5	7 5	7 5	10 5	10 5
	With IGV's					10.2*	10 2*	10 2	10 2	9 4	9 4	8 9	8 9	8 9	8 9	7 4	7 4
57	W/O IGV's							8.0*	8.0*	8.0	8.0	7 5	7 5	7 5	7 5	10 5	10 5
	With IGV's							7 7*	7 7*	6 9	6 9	6 4	6 4	6.4	6.4	4 9	4 9

UNIT SIZE	IGV OPTION	MOTOR FRAME							
		324T		326T		364T		365T	
		Motor Type							
		ODP	TEFC	ODP	TEFC	ODP	TEFC	ODP	TEFC
29	W/O IGV's								
	With IGV's								
36	W/O IGV's	5 2*	5 2*						
	With IGV's	5.3*	5.3*						
39	W/O IGV's	5.2*	5.2*	5.2*	5.2*				
	With IGV's	6.0*							
48	W/O IGV's	11 0	11 0	9 5*	9 5*	9 7*	9 7*	8 7*	8 7*
	With IGV's	12.3	12.3	10.9*	10.9*	11.0*	11.0*	10.0*	10.0*
57	W/O IGV's	11.0	11 0	9 5	9 5	9 7*	9 7*	8 7*	8 7*
	With IGV's	9 9	9 9	8 4	8 4	8 6*	8 6*	7 6*	7 6*

Shaded area indicates that space is not available for mounting of motor

IGV — Inlet Guide Vanes
ODP — Open Drip Proof Motor
TEFC — Totally Enclosed Fan-Cooled Motor

*Indicates drive package available on special order only
†Indicates that T-frame motor fits but fan section extension (Option L5) is required

NOTES
1 The maximum sheave widths were derived on the basis of T-frame motor dimensions shown in Fig 1.
2 Use of U-frame, 2-speed or high-efficiency motors may affect the maximum allowable sheave width

Table 4 — Maximum Physical Motor Frame Size and Maximum Allowable Sheave Width (in.) — Airfoil Fans

UNIT SIZE	IGV OPTION	MOTOR FRAME															
		145T		182T		184T		213T		215T		254T		256T		284T	
		Motor Type															
		ODP	TEFC	ODP	TEFC	ODP	TEFC	ODP	TEFC	ODP	TEFC	ODP	TEFC	ODP	TEFC	ODP	TEFC
08	With or Without IGV	3.62		5.75		5.75		5.0		3.37	3.37*						
11		7.75		7 05		7 05		6 35		6 35	4 5	4 5	5 15				
13		7 35		6 85		6 85	5 85	6 0	5 25	6 0	3 65	4 85					
17				8 05		8 05		7 25		7 25	7 2	6 55	4.25	5 05	5 05		
19				8.15		8.15		7.3	7.15	7.3	5.8	5 55	6 50	5 15			
23				8 45		8 45		7 75		7 75		7 1	5 3	5 85	5 85	5 75	5 75

UNIT SIZE	IGV OPTION	MOTOR FRAME															
		182T		184T		213T		215T		254T		256T		284T		286T	
		Motor Type															
		ODP	TEFC	ODP	TEFC	ODP	TEFC	ODP	TEFC	ODP	TEFC	ODP	TEFC	ODP	TEFC	ODP	TEFC
29	With or Without IGV	4 4		4 4		3 65		3 65		5.5	5 5†	5 5 †		4 9†		4 75†	
36		5 75		5 75		4 75		4 75		6 55		6 55		6 0		5.75	
39		5 5		5 5		4 75		4 75		8 0		7.5		7.5		6.0	
48								8.0		8.0		7.5		7.5		6.0	
57								8.0		8.0		7.5		7.5		6.0	
75										6.25		6.0		5.5		5.5	
90										6 25		6 0		5 5		5 5	

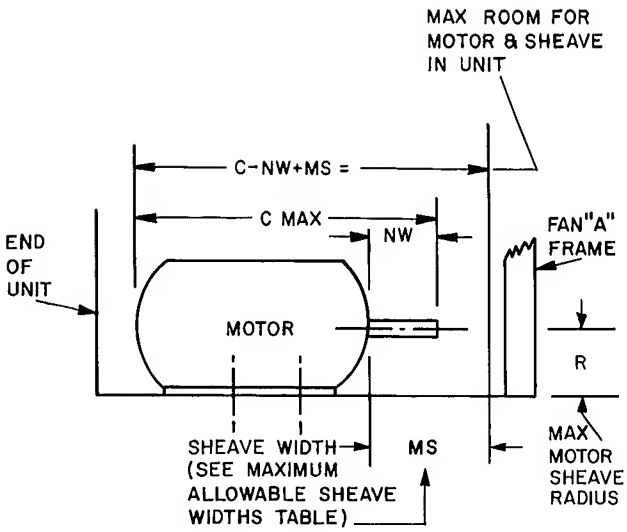
UNIT SIZE	IGV OPTION	MOTOR FRAME											
		324T		326T		364T		365T		404T		405T	
		Motor Type											
		ODP	TEFC	ODP	TEFC	ODP	TEFC	ODP	TEFC	ODP	TEFC	ODP	TEFC
29	With or Without IGV												
36		5 55	5 55†										
39		5 25		5 25	‡								
48		10 0		9 5		9 75	8 75	8 75	6 0				
57		10 0		9 5		9 75	8 75	8 75	6.0				
75		11 0		9 63		9 75		8 75		8 25		8 25	8 25*
90		11 0		9 63		9 75		8 75		8 25		8 25	8 25*

Shaded area indicates that space is not available for mounting of motor

IGV — Inlet Guide Vanes
ODP — Open Drip Proof Motor
TEFC — Totally Enclosed Fan-Cooled Motor

*Indicates that T-frame motor fits in non-internally isolated units only and fan section extension (Option L5) is required
†Indicates that T-frame motor fits but fan section extension (Option L5) is required
‡Indicates that T-frame motor fits but unit extension is required on Special Order

NOTES
1 The maximum sheave widths were derived on the basis of T-frame motor dimensions shown in Fig 1
2 Use of U-frame, 2-speed or high-efficiency motors may affect the maximum allowable sheave width



MOTOR		OPEN DRIP PROOF			TOTALLY ENCLOSED, FAN COOLED		
Frame	Shaft Diameter (in.)	C_{MAX}	NW	R	C_{MAX}	NW	R
145T	7/8	12 11/16	2 1/4	3 1/2	13 1/2	2 1/4	3 1/2
182T	1 1/8	14 1/8	2 3/4	4 1/2	15 11/16	2 3/4	4 1/2
184T		14 1/8	2 3/4	4 1/2	16 11/16	2 3/4	4 1/2
213T	1 3/8	15 3/4	3 3/8	5 1/4	18 3/16	3 3/8	5 1/4
215T		17 3/4	3 3/8	5 1/4	19 11/16	3 3/8	5 1/4
254T	1 5/8	20 9/16	4	6 1/4	23 1/8	4	6 1/4
256T		22 5/16	4	6 1/4	24 7/8	4	6 1/4
284T	1 7/8	23 7/16	4 5/8	7	26 3/16	4 5/8	7
286T		24 15/16	4 5/8	7	27 11/16	4 5/8	7
324T	2 1/8	26	5 1/4	8	28 3/4	5 1/4	8
326T		27 1/2	5 1/4	8	30 1/4	5 1/4	8
364T	2 3/8	28 5/8	5 7/8	9	32 1/2	5 7/8	9
365T		29 11/16	5 7/8	9	34 1/8	5 7/8	9
404T	2 7/8	32 5/8	7 1/4	10	37 1/4	7 1/4	10
405T		34 1/8	7 1/4	10	38 3/4	7 1/4	10

Fig. 1 — Physical Data, Motor and Drive Dimensions

ADVANTAGES OF INTERNALLY-MOUNTED, FACTORY-INSTALLED MOTORS

Motor is Protected from Shipping and Storage Damage — Unlike the externally-mounted factory-installed motor, the internally-mounted motor and drive are protected against damage and vandalism during shipping and jobsite storage. At start-up time, the unit requires only final drive tightening to be ready for operation.

Largest Possible Motor May Be Factory Installed — Externally-mounted motors can cause stress on the top of the fan section when cantilevered from the unit side casing panels thus limiting motor size. The internally-mounted motor is always mounted on a base located in the bottom of the fan section. This base is designed to support the weight of the largest (heaviest) motor that is compatible with a particular size unit.

Provides Longer Motor Life — Externally-mounted motors are often subjected to less than ideal ambient conditions that may contain dust or other airborne particles. Because internally-mounted motor is in airstream, the standard practice of using filters in the airstream (often higher efficiency filters) insures that clean filtered air passes over motor.

Increased Motor Service Factor — The service factor is the amount of continuous overload the motor can withstand without damaging the motor or decreasing design life. The lower the operating temperature of the motor, the longer the life of the motor.

The standard 1.15 service factor applied to integral frame open drip proof (ODP) motors and the 1.0 service factor applied to totally enclosed, fan-cooled (TEFC) motors are based on operation in an ambient temperature of 104 F (40 C).

The motor mounted in the airstream operates at a lower temperature than if mounted externally due to the cool, fast moving air passing over the motor As a result, motor life is extended. In cases where there is warm circulating air, the motor still runs at a lower temperature than if externally mounted due to the improved heat dissipating effect of the air passing over the motor.

Factory-supplied and installed motors have Class B insulation as standard for use in applications where motor is subjected to maximum ambient temperature of 104 F (40 C). When the motor will be subjected to higher temperatures, either from ambient temperature or high temperature heating applications, a special order motor with Class F insulation should be used

Table 5 — Allowable Centerline Distance (in.)

FORWARD-CURVED WHEEL

UNIT SIZE		08	11	13	17	19	23	29	36	39	48	57
FAN SHAFT DIAMETER (in.)		1 3/16	1 7/16	1 7/16	1 7/16	1 7/16	1 11/16	1 15/16	1 15/16	1 15/16	2 3/16	2 3/16
FRAME SIZE												
145	Max	12 30	11 33	11.33	—	—	—	—	—	—	—	—
	Min	10 50	9.30	9 30	—	—	—	—	—	—	—	—
182	Max	11 70	10 20	10 20	17 59	17 59	17.56	21 77	21 77	—	—	—
	Min	9 50	8 10	8 10	15 29	15 29	15 21	18 71	18 71	—	—	—
184	Max	11 70	10.20	10.20	17 59	17 59	17 56	21 77	21.77	—	—	—
	Min	9.50	8 10	8 10	15 29	15 29	15 21	18 71	18 71	—	—	—
213	Max	10 80	9 31	9 31	16 69	16 69	16 66	21 14	21 14	31 60	—	—
	Min	8 80	7 38	7 38	14 44	14 44	14 35	17 88	17.88	26 00	—	—
215	Max	—	9 31	9 31	16 69	16 69	16 66	21 14	21 14	31 0	37.40	—
	Min	—	7 38	7.38	14.44	14 44	14 35	17 88	17 88	26 0	31 50	—
254	Max	—	8.06	8 06	15 44	15 44	15 41	20 32	20 32	30 50	36 30	36 30
	Min	—	6.28	6 28	13 29	13 29	13 20	17 00	17 00	25 30	30 60	30.60
256	Max	—	—	—	15 44	15 44	15 41	20 32	20 32	30 50	36 30	36 30
	Min	—	—	—	13 29	13 29	13 20	17 00	17 00	25 30	30 60	30 60
284	Max	—	—	—	—	—	14 51	19 71	19 71	29 50	35 40	35.40
	Min	—	—	—	—	—	12 36	16 16	16 16	24 70	30 00	30 00
286	Max	—	—	—	—	—	—	19.71	19 71	29.50	35 40	35.40
	Min	—	—	—	—	—	—	16 16	16 16	24 70	30 00	30 00
324	Max	—	—	—	—	—	—	—	18 46	—	35 00	35 00
	Min	—	—	—	—	—	—	—	15.30	—	29 40	29 40
326	Max	—	—	—	—	—	—	—	—	—	—	35.00
	Min	—	—	—	—	—	—	—	—	—	—	29 40

FORWARD-CURVED WHEEL — MODUDRIVE UNITS

UNIT SIZE		08	11	13	17	19	23	29	36	39	48	57
FAN SHAFT DIAMETER (in.)		1 3/16	1 7/16	1 7/16	1 7/16	1 7/16	1 11/16	1 15/16	1 15/16	1 15/16	2 3/16	2 3/16
FRAME SIZE												
182	Max	—	—	—	14 7	14 7	—	—	—	—	—	—
	Min	—	—	—	10 9	10 9	—	—	—	—	—	—
184	Max	—	—	—	14 7	14 7	14 7	21 2	21 2	—	—	—
	Min	—	—	—	10 9	10 9	10 9	15 8	15 8	—	—	—
213	Max	—	—	—	14 0	14 0	14 0	20 6	20 6	30 6	—	—
	Min	—	—	—	10 0	10 0	10 0	15 7	15 7	25 5	—	—
215	Max	—	—	—	14 0	14 0	14 0	20 6	20 6	30 6	37.5	—
	Min	—	—	—	10 0	10 0	10 0	15 7	15 7	25.5	31.6	—
254	Max	—	—	—	13 5	13 5	13 5	19.5	19 5	30 0	36.9	36 9
	Min	—	—	—	12 3	12 3	12 3	14 8	14 8	24 8	30.6	30 6
256	Max	—	—	—	—	—	13 5	19 5	19 5	30 0	36.9	36 9
	Min	—	—	—	—	—	12 3	14 8	14 8	24 8	30 6	30 6
284	Max	—	—	—	—	—	—	20 0	20 0	30 0	36 9	36 9
	Min	—	—	—	—	—	—	15 0	15 0	24 8	29 9	29.9
286	Max	—	—	—	—	—	—	20 0	20 0	30 0	36.9	36.9
	Min	—	—	—	—	—	—	15 0	15 0	24 8	29.9	29 9

NOTE Allow for belt installation, initial tensioning and subsequent take-up Refer to drive manufacturer's recommendations.

Table 5 — Allowable Centerline Distance (in.) (cont)

AIRFOIL WHEEL

UNIT SIZE		08	11	13	17	19	23	29	36	39	48	57	75	90
FAN SHAFT DIAMETER (in.)		1 7/16	1 11/16	1 15/16	1 15/16	2 3/16	2 3/16	2 7/16	2 11/16	2 11/16	2 7/16	2 7/16	2 15/16	2 15/16
FRAME SIZE														
145	Max	12 3	11 62	11 6	—	—	—	—	—	—	—	—	—	—
	Min	10 5	9 26	9 17	—	—	—	—	—	—	—	—	—	—
182	Max	11 7	10.21	10 19	17 59	17 52	17 44	21 88	21 65	—	—	—	—	—
	Min	9 5	8 11	8 0	15 29	15 12	14.95	18.99	18.43	—	—	—	—	—
184	Max	11 7	10 21	10 19	17 59	17 52	17 44	21 88	21 65	—	—	—	—	—
	Min	9.5	8.11	8.0	15.29	15.12	14.95	18.99	18.43	—	—	—	—	—
213	Max	10 8	9 31	9 29	16 69	16 62	16 54	21 25	21 07	31 0	—	—	—	—
	Min	8.8	7 31	7 2	14.44	14.26	14.08	18.16	17.65	26.0	—	—	—	—
215	Max	9 75	9 31	9 29	16 69	16 62	16 54	21 25	21 07	31 0	—	—	—	—
	Min	7 31	7 31	7 2	14.44	14.26	14.08	18.16	17.65	26.0	—	—	—	—
254	Max	—	8 06	8 04	15 44	15 37	15 29	20 41	20 26	30 5	36.3	36 3	51.5	51 5
	Min	—	6.3	6.18	13.29	13.11	12.91	17.27	16.78	25.3	30.6	30.6	45.5	45.5
256	Max	—	—	—	15 44	15 37	15.29	20 41	20 26	30 5	36 3	36.3	51 5	51 5
	Min	—	—	—	13 29	13.11	12.91	17.27	16.78	25.3	30.6	30.6	45.5	45.5
284	Max	—	—	—	—	—	14 39	19 79	19 66	29 5	35 4	35 4	50.6	50 6
	Min	—	—	—	—	—	12.06	16.44	15.94	24.7	30.0	30.0	44.5	44.5
286	Max	—	—	—	—	—	—	19 79	19 66	29 5	35 4	35.4	50 6	50 6
	Min	—	—	—	—	—	—	16 44	15 94	24.7	30.0	30.0	44.5	44.5
324	Max	—	—	—	—	—	—	—	18 41	29 5	35 0	35 0	50 1	50 1
	Min	—	—	—	—	—	—	—	15.1	24.3	29.4	29.4	44.0	44.0
326	Max	—	—	—	—	—	—	—	—	29 5	35 0	35 0	50 1	50 1
	Min	—	—	—	—	—	—	—	—	24.3	29.4	29.4	44.0	44.0
364	Max	—	—	—	—	—	—	—	—	—	33 8	33 8	48 8	48.8
	Min	—	—	—	—	—	—	—	—	—	28.5	28.5	42.5	42.5
365	Max	—	—	—	—	—	—	—	—	—	—	33 8	48 8	48 8
	Min	—	—	—	—	—	—	—	—	—	—	28.5	42.5	42.5
404	Max	—	—	—	—	—	—	—	—	—	—	—	47 7	47.7
	Min	—	—	—	—	—	—	—	—	—	—	—	41.0	41.0
405	Max	—	—	—	—	—	—	—	—	—	—	—	47 7	47 7
	Min	—	—	—	—	—	—	—	—	—	—	—	41 0	41 0

AIRFOIL WHEEL — MODUDRIVE UNITS

UNIT SIZE		08	11	13	17	19	23	29	36	39	48	57	75	90
FAN SHAFT DIAMETER (in.)		1 7/16	1 11/16	1 15/16	1 15/16	2 3/16	2 3/16	2 7/16	2 11/16	2 11/16	2 7/16	2 7/16	2 7/16	2 15/16
FRAME SIZE														
182	Max	—	—	—	14 7	14 7	—	—	—	—	—	—	—	—
	Min	—	—	—	10.9	10.9	—	—	—	—	—	—	—	—
184	Max	—	—	—	14 7	14 7	14 7	21 2	21.2	—	—	—	—	—
	Min	—	—	—	10 9	10.9	10.9	16.2	16.2	—	—	—	—	—
213	Max	—	—	—	14 0	14 0	20 6	20 6	20 5	30 6	—	—	—	—
	Min	—	—	—	10.0	10.0	16.0	16.0	15.5	25.5	—	—	—	—
215	Max	—	—	—	14 0	14.0	14 0	20 6	20 5	30.6	37 5	—	—	—
	Min	—	—	—	10.0	10.0	9.9	16.0	15.5	25.5	31.6	—	—	—
254	Max	—	—	—	13 5	13 5	13 5	19 6	19.5	30 0	36 9	36 9	52 3	52 3
	Min	—	—	—	12.3	12.3	12.1	15.2	14.5	24.8	30.6	30.6	44.6	44.6
256	Max	—	—	—	13 5	13 5	13 5	19 6	19 5	30 0	36 9	30 9	52 3	52 3
	Min	—	—	—	12 3	12 3	12 1	15.2	14.5	24.8	30.6	30.6	44.6	44.6
284	Max	—	—	—	—	—	—	20 1	20 0	30.0	36 9	36 9	52.1	52 1
	Min	—	—	—	—	—	—	15.3	14.8	24.8	29.9	29.9	44.3	44.3
286	Max	—	—	—	—	—	—	20.1	20 0	30 0	36 9	36 9	52 1	52 1
	Min	—	—	—	—	—	—	15 3	14 8	24 8	29 9	29.9	44 3	44 3

NOTE: Allow for belt installation, initial tensioning and subsequent take-up Refer to drive manufacturer's recommendations

APPLICATION CONSIDERATIONS

Heat Gain from Electrical Motors — Some misconceptions exist regarding the heat added to the airstream by central-station units having internally-mounted motors versus units that have their motors externally mounted. This topic can be found in the Carrier System Design Manual, Part 1, Load Estimating. Typical values of the heat added by internally- and externally-mounted motors over a range of sizes and motor heat generation are discussed. Briefly stated:

The central-station unit with externally-mounted motors adds heat to the supply air which can be calculated by using the formula:

$$\text{Heat Added, Btuh} = \text{Bhp} \times 2545$$

The central-station unit with an internally-mounted motor adds heat to the supply air which can be calculated by using the formula

$$\text{Heat Added, Btuh} = \frac{\text{Bhp} \times 2545}{\%\ \text{Motor Efficiency}}$$

The additional heat that an internally-mounted motor adds to the airstream compared to that of an externally-mounted motor can be calculated by using the formula:

$$\text{Additional Heat Added, Btuh} = \frac{\text{Bhp} \times 2545\ (1 - \%\ \text{Motor Efficiency})}{\%\ \text{Motor Efficiency}}$$

When the apparatus room is used as a plenum, the fan motor and all other motors in the room are in the airstream. Therefore, even though the central-station unit motors are externally mounted, they are still in the airstream and the same amount of heat is added as if internally-mounted motors were used.

Additional Information which is useful in selecting motors and drives is shown in Tables 6 through 14.

Table 6 — Motor Mounting Designation

DISCHARGE ARRANGEMENT		DRIVE AND ACCESS DOOR HAND†	
		Left	Right
Top Horizontal Front,	THF	F_2	F_1
Bottom Horizontal Front,	BHF	F_1	F_2
Upblast Front,	UBF	F_2	F_1
Upblast Rear,	UBR	F_1	F_2
Downblast,	DB	F_1	F_2
Top Horizontal Rear,*	THR	F_1	F_2
Bottom Horizontal Rear,*	BHR	F_2	F_1

*Vertical fan sections only
†Sizes 48-90 use F1 motor position for all discharges

NOTES
1. When ordering replacement motors, the conduit box MUST be installed in the correct location on the motor, or there will be interference and the motor will not fit into unit properly
2. In many cases the motor vendor supplies a motor with the conduit box located on top of the motor

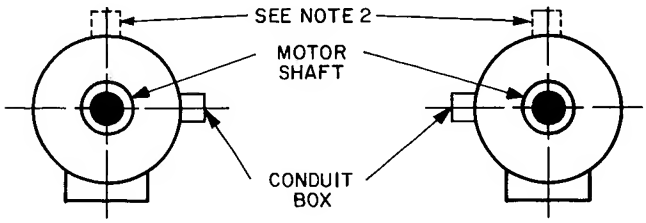


Table 7 — Typical Values of Full Load Amps at 460 Volts for Standard Motors*

MOTOR HP	1800 RPM			3600 RPM			
	Frame†	ODP	TEFC	Frame	ODP	Frame	TEFC
2	145T	—	3 0	—	—	—	—
3	182T	—	5 0	145T	—	182T	4 1
5	184T	7 3	6 7	182T	6 9	184T	6 3
7.5	213T	10 5	9.8	184T	9 3	213T	9 5
10	215T	12 6	13 4	213T	13 0	215T	12 5
15	254T	20 0	18 0	215T	19 0	254T	18 3
20	256T	25 0	24.5	254T	23 0	256T	24 5
25	284T	31 5	32 0	256T	29 0	—	—
30	286T	37 0	35 0	—	—	—	—
40	324T	48 0	50.0	—	—	—	—
50	326T	60 0	62.0	—	—	—	—
60	364T	70 0	70 0	—	—	—	—
75	365T	87.0	86 0	—	—	—	—
100	404T	116 0	—	—	—	—	—
100	405T	—	115 0	—	—	—	—

ODP — Open Drip Proof
TEFC — Totally Enclosed Fan-Cooled

*Amps will be doubled for 230 volts
†TEFC, 1800 rpm motors use the same size frame as ODP, 1800 rpm motors

NOTES.
1 Frame sizes given above apply to motors for which standard drives are available
2 Amp values are based on Magnetex Century-Electric motors For data on other manufacturers, consult their catalog.

Table 8 — Typical Performance High Efficiency 1800 Rpm Motors at 460 Volts

HP	FRAME	ODP			TEFC		
		Full Load Amps	Efficiency	Power Factor	Full Load Amps	Efficiency	Power Factor
2	145T	2.6	84.0	85 7	3 0	84.0	78 5
3	182T	3 9	85 5	86 5	3.8	86.5	85 5
5	184T	6 0	86 5	88 0	6 2	86 5	88 0
7.5	213T	9.8	88 5	82.5	9 8	87 5	84 5
10	215T	12 2	89.5	85 5	12 2	88 5	85 5
15	254T	18 3	90 2	84 5	18 3	90 2	84.5
20	256T	24 0	91.0	86.0	24.5	91 7	85 4
25	284T	31 0	91 7	84.0	30.0	92.4	85 0
30	286T	34 5	92 4	89.0	34.5	92 4	88 5
40	324T	48 5	93.0	88 0	46.0	93.0	89.5
50	326T	59.0	93.0	89 0	56 0	93.0	89 0
60	364T	68.6	93 0	88 0	67.0	93 0	88 0
75	365T	85 3	93 6	88 0	83.9	93.6	88 0
100	404T	114 0	94.5	86.0	—	—	—
100	405T	—	—	—	115 0	94.5	87 0

ODP — Open Drip Proof
TEFC — Totally Enclosed Fan-Cooled

NOTES:
1 Frame sizes given above apply to motors for which standard drives are available
2 Amp values are based on Magnetex Century-Electric motors For data on other manufacturers, consult their catalog

Table 9 — Typical Performance High Efficiency, 3600 Rpm Motors at 460 Volts

HP	ODP				TEFC			
	Frame	Full Load Amps	Efficiency	Power Factor	Frame	Full Load Amps	Efficiency	Power Factor
2	145T	2 6	82 5	87 3	—	—	—	—
3	145T	3 9	84 0	85 7	182T	3 9	82 5	92 0
5	182T	6.3	85.5	86.9	184T	6.2	85.5	88.3
7.5	184T	9.2	93.0	86.5	213T	9.4	86.5	86.4
10	213T	12.4	87.5	88.0	215T	12 0	86.5	89.5
15	215T	17.6	89.5	89 2	254T	17.4	88.5	91.2
20	254T	23 1	90 2	89 8	256T	23 0	90 2	93 5
25	256T	28.2	90 2	92 0	—	—	—	—

ODP — Open Drip Proof
TEFC — Totally Enclosed Fan-Cooled

NOTES:
1 Frame sizes given above apply to motors for which standard drives are available
2 Amp values are based on Magnetex Century-Electric motors For data on other manufacturers, consult their catalog

Table 10 — Typical Performance ODP, 2-Speed Motors

RATED HP	FRAME	FULL LOAD AMPS AT 460 VOLTS	OPERATING HP	
			High Speed	Low Speed
TWO-SPEED 1800/900 RPM — ONE WINDING				
1/.25	143T	1.8/.75	1	.12
1.5/.37	145T	2.25/.95	1½	.19
2/.5	145T	3.0/1.3	2	.25
3/.75	182T	4.9/1.9	3	.375
5/1.2	184T	7.0/2.7	5	.63
7.5/1.9	213T	10.5/4.2	7½	.94
10/2.5	215T	13.0/5.5	10	1.25
15/3.7	256T	19 4/7.2	15	1.87
20/5	254T	26.0/10.0	20	2.50
25/6.2	286T	35.0/11.0	25	3.12
30/7.5	286T	35.0/18 0	30	3.75
40/10	326T	50 0/17 0	40	5.00
50/12.5	326T	63 0/20 0	50	6 25
TWO-SPEED 1800/1200 RPM — 2 WINDING				
1/.44	145T	1.7/1.1	1	.30
1.5/.68	145T	2.4/1.4	1½	.44
2/.88	182T	3.4/2.1	2	.59
3/1.3	184T	4.6/2 6	3	.89
5/2.2	215T	7.1/4.8	5	1.48
7.5/3.3	215T	10.0/6.0	7½	2.22
10/4.4	256T	13.5/7.5	10	2.96
15/6.7	256T	19.0/11.0	15	4.40
20/8.9	286T	24.0/12.0	20	5.93
25/11	324T	33.0/16.0	25	7.40
30/13	326T	38.0/18.0	30	8.90
40/18	326T	46.0/23.0	40	11.87
50/22	365T	64 0/30.0	50	14.84
TWO-SPEED 1800/900 RPM — 2 WINDING				
1/.25	145T	1.8/.9	1	.12
1.5/.37	145T	2 3/1 2	1½	.19
2/.5	182T	3 3/1.4	2	.25
3/.75	184T	4 5/2 0	3	.37
5/1.2	215T	7.1/3.3	5	.63
7.5/1.9	215T	9.5/4.5	7½	.94
10/2.5	256T	13.0/6.0	10	1.25
15/3.7	256T	18 5/8 0	15	1.87
20/5	286T	25.0/9.5	20	2.50
25/6.2	286T	31 0/11 0	25	3.12
30/7.5	324T	36 0/13 0	30	3.75
40/10	364T	50.0/19.0	40	5.00
50/12.5	365T	60 0/21 0	50	6 25

Table 11 — Typical Performance — TEFC, 2-Speed Motors

RATED HP	FRAME	FULL LOAD AMPS AT 460 VOLTS	OPERATING HP	
			High Speed	Low Speed
TWO-SPEED 1800/900 RPM — ONE WINDING				
1/.25	143T	1.8/.75	1	.12
1.5/.37	145T	1.95/.85	1½	.19
2/.5	145T	3.2/1.3	2	.25
3/.75	182T	4.2/1.6	3	.375
5/1.2	184T	6.5/2.5	5	.63
7.5/1.9	213T	10.5/4.2	7½	.94
10/2.5	215T	13.5/5.5	10	1.25
15/3.7	256T	19 5/7 5	15	1.87
20/5	254T	26.0/9.0	20	2.50
25/6.2	286T	33.0/11.0	25	3.12
30/7.5	324T	35.5/13.4	30	3.75
40/10	326T	50.0/15 0	40	5.00
50/12.5	326T	61 5/22 4	50	6.25
TWO-SPEED 1800/1200 RPM — 2 WINDING				
1/.44	145T	1.7/1.1	1	.30
1.5/.68	145T	2.5/1.4	1½	.44
2/.88	182T	3.0/1.7	2	.59
3/1.3	184T	4.4/2.6	3	.89
5/2.2	213T	7.1/4.8	5	1.48
7.5/3.3	215T	10.0/7.5	7½	2.22
10/4.4	254T	13.5/7.5	10	2.96
15/6.7	256T	18.6/9.8	15	4.40
20/8.9	284T	24 0/12.0	20	5.93
25/11	286T	30.0/15.0	25	7.40
30/13	324T	36.0/19.0	30	8.90
40/18	326T	48.0/24.0	40	11.87
50/22	364T	59.0/28 0	50	14.84
TWO-SPEED 1800/900 RPM — 2 WINDING				
1/.25	145T	1.8/.9	1	.12
1.5/.37	145T	2 1/ 95	1½	.19
2/.5	182T	3.3/1.4	2	.25
3/.75	184T	4 3/2 0	3	.37
5/1.2	213T	7.0/3.5	5	.63
7.5/1.9	215T	9.6/4.3	7½	.94
10/2.5	254T	13.0/5.6	10	1.25
15/3.7	256T	19.0/7.5	15	1.87
20/5	284T	25.0/9.0	20	2.50
25/6.2	286T	30.0/11.0	25	3.12
30/7.5	324T	36.0/13 0	30	3.75
40/10	326T	48.0/16.0	40	5.00
50/12.5	364T	59 0/20 0	50	6 25

Table 12 — Typical Motor Weights

HP	1800 RPM			3600 RPM			
	Frame	ODP	TEFC	ODP		TEFC	
		Weight	Weight	Frame	Weight	Frame	Weight
2	145T	—	55	—	—	—	—
3	182T	58	90	145T	—	182T	79
5	184T	68	105	182T	58	184T	95
7.5	213T	88	149	184T	70	213T	139
10	215T	112	179	213T	93	215T	170
15	254T	172	253	215T	115	254T	243
20	256T	205	297	254T	215	256T	288
25	284T	284	366	256T	240	—	—
30	286T	324	429				
40	324T	436	477				
50	326T	489	526				
60	364T	632	770				
75	365T	676	865				
100	404T	932	1273				

ODP — Open Drip Proof
TEFC — Totally Enclosed, Fan-Cooled

NOTES
1 Frame sizes given above apply to motors for which standard drives are available
2 Two-speed motors are heavier and require isolator spring changes per special order

High-Efficiency Motors are available from most motor manufacturers for a relatively small price premium (20 - 30%). Available in the same frame size as the standard motor, these motors may be an inch or more longer (C_{max}), and are generally 5 - 7% more efficient, (though some may be little more than 0.5 - 1.0%). Over their lifetime, some can pay for themselves many times over For purposes of comparison, their power savings can be represented as follows:

$$\text{Power Savings}(\%) = \frac{\text{Eff}_{Hi} - \text{Eff}_{Std}}{\text{Eff}_{Hi} \times \text{Eff}_{Std}}$$

$$\$ \text{ Savings} = \text{Power Savings}(\%) \times 0.746 \times \text{Hp} \times \text{Oper hrs} \times \text{Rate}_{kW \cdot hr}$$

Multi-Speed Motors of high efficiency can provide an even greater savings in operating costs in certain applications. Typical of these would be an air handler that on occasion operates at reduced air quantities (e.g., night air circulation).

Multi-speed motors, either 1/2-speed (1800/900 rpm, one- or 2-winding) or 2/3-speed (1800/1200 rpm, 2-winding), show by the fan laws, the following comparison of low-speed performance to standard speed performance.

Motor/Fan Speed (N):	0.500	0.667
Air Quantity (N):	0.500	0.667
Static Pressure (N^2):	0.250	0.444
Fan Bhp (N^3):	0.125	0.296

where N is the speed ratio.

In application, the fan's performance would be as shown by its characteristic performance curve (in the Fan Performance Catalog) at the reduced fan speed and bhp.

Multi-speed motors may be one or 2 frame sizes larger, several inches longer overall (C_{max}), and carry a 50% to 250% price premium over the standard motor. Because of larger losses (copper, iron and friction), multi-speed motors can never realize the same reduction in input power requirements as in bhp (N^3), though they show substantial reductions in full load amps (FLA) at slow speeds. Properly applied, they can provide large savings in power costs and a very short payback period. But exercise caution not to sacrifice equipment performance for economy.

Demand Charges/Part-Load Start — In the usual commercial or industrial application, the starting of the typical standard air-handler motor makes little, if any difference in the rate that the typical utility charges for its power. Ordinarily, any starting currents are lost in the overall power consumed by the facility. If motor starting currents appear to be a problem, explore the matter with your Carrier sales representative.

Table 13 — Motor Frame Sizes, Open Drip Proof, 60 Hz

MOTOR HP	STANDARD		SPECIAL ORDER										
	1800 Rpm	3600 Rpm	1800 Rpm	3600 Rpm	1800/900 Rpm One Winding		1800/900 Rpm Two Winding		1800/1200 Rpm Two Winding		3600/1800 Rpm One Winding		1800 Rpm High Efficiency
2	145T	145T	184	184	145T	145T	182T	182T	182T	182T	145T	145T	145T
3	182T	145T	213	184	182T	182T	184T	184T	184T	184T	145T	145T	182T
5	184T	182T	215	213	184T	184T	215R	213T	215T	213T	182T	182T	184T
7½	213T	184T	254U	215	213T	213T	254T	215T	315T	215T	184T	184T	213T
10	215T	213T	256U	254U	215T	215T	256T	254T	256T	254T	215T	213T	215T
15	254T	215T	284U	256U	256T	254T	284T	256T	256T	256T	215T	215T	256T
20	256T	254T	286U	284U	254T	256T	286T	284T	286T	284T	254T	254T	256T
25	284T	256T	324U	286U	286T	284T	324T	286T	324T	286T	256T	256T	286T
30	286T	—	326U	—	286T	286T	326T	324T	326T	324T	—	—	286T
40	324T	—	364U	—	326T	324T	364T	326T	384T	326T	—	—	324T
50	326T	—	365U	—	326T	326T	365T	364T	365T	364T	—	—	326T
60	364T	—	404U	—	365T	364T	404T	365T	404T	365T	—	—	364T
75	365T	—	405U	—	404T	365T	404T	404T	404T	404T	—	—	365T
100	404T	—	444U	—	405T	404T	405T	405T	405T	405T	—	—	404T
MOTOR VENDOR			C	R	C	R	C	R	C	R	C	R	C

Table 14 — Motor Frame Sizes, Totally Enclosed Fan Cooled, 60 Hz

MOTOR HP	STANDARD		SPECIAL ORDER											
	1800 Rpm	3600 Rpm	1800 Rpm	3600 Rpm	1800/900 Rpm One Winding		1800/900 Rpm Two Winding		1800/1200 Rpm Two Winding		1800 Rpm High Efficiency		3600 Rpm High Efficiency	
2	145T	145T	184	184	145T	145T	182T	182T	182T	182T	145T	P145T	145T	P145T
3	182T	182T	213	184	182T	182T	184T	184T	184T	184T	182T	F182T	182T	F182T
5	184T	184T	215	213	184T	184T	215T	215T	215T	215T	184T	F184T	184T	F184T
7½	213T	213T	254U	215	215T	215T	254T	254T	254T	254T	213T	P213T	213T	F213T
10	215T	215T	256U	254U	215T	215T	256T	254T	256T	256T	215T	F215T	215T	F215T
15	254T	254T	284U	256U	256T	256T	284T	284T	284T	284T	254T	FG254T	254T	FD254T
20	256T	256T	286U	286U	284T	284T	286T	286T	286T	286T	256T	FD2561	256T	FD256T
25	284T	—	324U	324U	286T	286T	324T	324T	324T	324T	284T	284T	284TS	284TS
30	286T	—	326U	—	324T	324T	324T	326T	324T	326T	286T	286T	286TS	286TS
40	324T	—	364U	—	324T	326T	326T	364T	364T	364T	324T	324T	324TS	324TS
50	326T	—	365U	—	326T	364T	364T	365T	364T	365T	326T	326T	326TS	326TS
60	364T	—	405U	—	364T	365T	365T	404T	365T	404T	364T	364T	364TS	364TS
75	365T	—	444U	—	365T	404T	404T	405T	404T	405T	365T	365T	365TS	365TS
100	405T	—	445U	—	405T	444T	444T	444T	444T	444T	405T	405T	405TS	405TS
MOTOR VENDOR			C	R	C	R	C	R	C	R	R	C	R	C

Legend and Notes (Tables 13 and 14)

All motors in section below shaded area are special order, available on quote control

C — Magnetex-Century Electric
R — Reliance

NOTES
1 Motor frame sizes subject to change. Check motor manufacturer's most recent listings before ordering
2 Some of the high-efficiency motors are approximately 2 in. longer than standard rpm/frame sizes Check Tables 3 and 4 for fan section fit when selecting these motors